UTILITY PATENT APPLICATION TRANSMITTAL LETTER

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Docket No.
GR 99 P 5540

To the Assistant Commissioner for Patents:

Transmitted herewith for filing is the patent application of:
Alois BIEBL and Guenther HIRSCHMANN
corresponding to German application 199 31 689.9, filed July 8, 1999,
entitled: OPTOELECTRONIC COMPONENT GROUP

Enclosed are:

X	10 pages of specification.
X	1 sheets of formal drawings.
X	a newly-executed declaration of the inventors.
	a copy of an executed declaration of the inventor from prior application Serial No. , filed .
	incorporation by reference. The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied as indicated in the preceding box, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.
X	an assignment of the invention to Patent-Treuhand-Gesellschaft fuer elektrische Gluehlampen mbH, including assignment cover sheet.
X	Information Disclosure Statement with Form PTO-1449.
X	copies of the Information Disclosure Statement citations.
	preliminary amendment.
X	return receipt postcard (MPEP 503), specifically itemized.
	a verified statement to establish small entity status under 37 CFR 1.9 and 1.27.
	a verified statement to establish small entity status filed in prior application. Status is still proper and desired.
X	a certified copy of the German application 199 31 689.9 Priority Document.
X	other: Inventors Information Sheet.

If a CONTINUING APPLICATION, *check appropriate box and supply the requisite information.*

[] Continuation [] Divisional [] Continuation-in-part (CIP)

of prior application No. , filed .

X	Customer No.
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UTILITY PATENT APPLICATION TRANSMITTAL LETTER (continued)	Docket No. GR 99 P 5540

jc861 U.S. PTO 09/604423 06/26/00

CLAIMS AS FILED

	NO. FILED	NO. EXTRA	RATE	FEE
BASIC FEE			$ 690	$ 690
TOTAL CLAIMS	13 - 20 =	0	x$ 18	
INDEPENDENT CLAIMS	2 - 3 =	0	x$ 78	
MULTIPLE DEPENDENT CLAIM PRESENT			$ 260	
			TOTAL	$690
If applicant has small entity status under 37 CFR 1.9 and 1.27, then divide total fee by 2, and enter amount here.			**SMALL ENTITY TOTAL**	$

X	A check in the amount of $730 to cover the filing fee is enclosed.
X	The Commissioner is hereby authorized to charge indicated fees and credit any overpayments to Deposit Account No. 25-0120 in the name of Young & Thompson, as described below. A duplicate copy of this sheet is enclosed.
	Charge the amount of $ as filing fee.
X	Credit any overpayment.
X	Charge any additional fee required under 37 CFR 1.16 and 1.17, during the pendency of this application.
	Charge the issue fee set in 37 CFR 1.18 at the mailing of the Notice of Allowance.

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APPLICATION INFORMATION

Title Line One::	OPTOELECTRONIC COMPONENT GROUP
Total Drawing Sheets::	1
Formal Drawings?::	YES
Application Type::	Utility
Docket Number::	GR 99 P 5540

REPRESENTATIVE INFORMATION

Representative Customer Number::

CONTINUITY INFORMATION

This application is a::	Claims benefit of
>Application One::	German Application 199 31 689.9
Filing Date::	July 8, 1999

PRIOR FOREIGN APPLICATION

Foreign Application One::	Application 199 31 689.9
Filing Date::	July 8, 1999
Country::	Federal Republic of Germany
Priority Claimed::	YES

Optoelectronic component group

Technical field

The invention relates to an optoelectronic component group in accordance with the preamble of Claim 1. This concerns, in particular, LED arrays which are arranged in a planar manner, for example surface lighting luminaires.

Prior art

WO 99/07023 has already disclosed an optoelectronic component group in which a chip support has external connecting parts for the purpose of heat dissipation. However, this arrangement is very complicated and expensive and takes up a lot of space.

EP-A 99 100 352.6 has disclosed a surface lighting luminaire with a common support on which a plurality of LEDs form a planar array. In EP-A 900 971, the support used is a glass plate on which conductor tracks are also fitted.

Summary of the invention

The object of the present invention is to provide an optoelectronic component group in accordance with the preamble of Claim 1 which realizes good heat dissipation in a simple, cost-saving and space-saving manner.

This object is achieved by means of the characterizing features of Claim 1. Particularly advantageous refinements can be found in the dependent claims.

Since LEDs heat up, care must be taken to ensure that the thermal load is kept as small as possible. This problem arises particularly when a plurality of LEDs are combined to form a section, as in the case of a lamp for example, or an array, as in the case of a surface lighting luminaire for example. To date, care has always had to be taken to ensure that the packing density of the LEDs is not chosen to be too close. The minimum distance that has been customary heretofore is 8 to 10 mm (in other words about 1 LED/cm^2), in order to keep the extent of mutual heating as small as possible. This is because excessively great heating, beyond the junction temperature of the LED chip, leads to shortening of the service life through to destruction. The previous relatively large minimum distance guarantees that each LED only has to cope with its inherent heat. In order nevertheless to produce a homogeneously illuminated surface, reflectors have been used heretofore. In addition, a diffusing screen is applied as a covering. These parts necessitate additional costs.

According to the invention, a material which has a good heat dissipation (better than the conventional printed circuit board material such as FR 1 to 4 or CEM 1) is now used as the support for the component group containing LEDs. In particular, a ceramic substrate of the kind already known per se in the semiconductor industry (based on aluminium oxide or else AlN), non-conducting cermet or composite material is suitable for this purpose. This includes both a material mixed from two components (for example epoxy resin with inorganic filling material), and a material with a layer structure (for example ceramic as upper layer (aluminium oxide) and metal (aluminium) as lower layer).

This means that it is now possible to dispense partly or even entirely with reflectors, depending on the

desired degree of homogeneity. With a relatively large distance (3 to 5 mm) between the LEDs, it is advantageous also to continue to use a diffusing screen as a covering. A covering is in any case advisable or, under certain circumstances, even dictated by regulation, depending on the application. However, the diffusing screen is no longer absolutely necessary, since the distance between the LEDs can, owing to the good heat dissipation, be chosen to be very small, in particular below 2 mm, down to values of about 1 mm.

Overall, according to the invention, the heat dissipation is essentially effected by way of the support material. The packing density of the LEDs can thereby be increased. Instead of 1 LED/cm^2, packing densities of typically up to 4 LED/cm^2 or higher are now possible.

In detail, the present invention relates to an optoelectronic component group which is mounted on a support and which comprises at least two adjacent LEDs at a prescribed distance (a), and also associated connecting lines, where the support is composed of a material having a thermal conductivity of better than 1 W/K×m, in particular of at least 1.5 W/K×m.

Preferably, the support is composed of a material which can be populated by means of SMD technology. In particular, the support is composed of a material which is selected from the group consisting of ceramic, non-conducting cermet, plastic and/or composite material, where further, in particular electronic component parts may be integrated on the support.

Given a suitable choice of the material, at least one further component can be fixed on the support. This component may be an electronic circuit, in particular an integrated circuit or complete drive circuit, or one to a plurality of LEDs. A component group of this type

may, in particular, be a component part of a surface lighting luminaire or lamp.

The LEDs on the support are usually arranged regularly. By way of example, they form a section or an array, with a prescribed distance (a and b) in the rows and columns, respectively. The row and column distances may, in particular, be identical.

The essential consequence of the suitable choice of the support material is the considerably reduced distance between two adjacent LEDs. It is at most 5 mm, preferably less than 2 mm.

For special applications, the support may be mounted on a further heat-dissipating material, in particular a separate thermal plate or body part of a vehicle.

In a particularly preferred embodiment, the structural height of the group is less than 10 mm, which is of considerable importance principally for surface lighting luminaires.

A further embodiment is an optoelectronic component group which is mounted on a support and which comprises at least two adjacent LEDs, which are spaced apart from one another, and also associated connecting lines. The support is composed of a material which dissipates heat well enough to realize a distance between adjacent LEDs of at most 5 mm, preferably less than 2 mm, without limiting the specified forward current of the LEDs (for example 70 mA in the case of TOPLED) and without further aids such as, for example, cooling fins.

In a particularly preferred embodiment, the support material is mounted on other heat dissipators (for example a separate thermal plate), with the result that the heat dissipation is additionally improved. This applies, in particular, when the component group is

used as a rear luminaire for vehicles, in which case sheet-metal body parts can perform the function of the additional heat dissipator.

By virtue of this mounting possibility, the LEDs can now be loaded up to the uppermost limit that is physically possible, the junction temperature. On the other hand, the luminance can also be increased because the forward current I_F of the LED can be increased.

A crucial advantage of the present invention is that, on the readily thermally conductive support, in particular a ceramic support, further structural parts or components can also additionally be constructed and, in particular, can even be integrated with the LEDs, in particular electronic circuits. By way of example, ceramic material is highly suitable as a basis for the integration of integrated circuits. Such circuits are required in any case for many applications; by way of example, protective circuits, monitoring functions and interfaces to bus systems are involved.

Extremely high compaction is possible as a consequence. This makes it possible for example to reduce the wiring harness in a car to one data line and one supply line. In this case, the drive circuit is concomitantly applied to the (ceramic) support.

Figures

The invention will be explained in more detail below using a number of exemplary embodiments. In the figures:

Figure 1 shows a surface lighting luminaire with LEDs;
Figure 2 shows a further exemplary embodiment of a surface lighting luminaire in which a circuit is integrated.

Description of the drawings

Figure 1 shows a component group 1 comprising a rectangular array of white LEDs 2 which enable a surface to be illuminated homogeneously. The associated connecting lines (4) are illustrated in a greatly simplified manner. The LEDs used are forward-radiating LEDs (for example SMT TOPLED from Siemens). The common support 3 is composed for example of a ceramic material, such as aluminium oxide, or of a composite material such as HITT Plate from DENKA Chemicals. The latter material is composed of a lower layer of aluminium, a thermally conductive upper dielectric layer made of epoxy resin (typical printed circuit board material) with inorganic filling constituents and also possibly locally of a thin covering layer made of copper. The table below shows a comparison of the thermal conductivity of various substances (at 20°C).

Material	CEM 1 (DN 9103) and FR 2 (DN 8033)	Al_2O_3 and AlN	HITT Plate K-1 and HITT Plate TH-1	Quartz glass	Aluminium and Copper
Type	Printed circuit board	Ceramic	Composite material	Glass	Metal
Thermal conduc-tivity (in W/K×m)	0.26 and 0.24	ca. 30 and ca. 170	1.8 and 3.5	0.1	220 and 384

Table 1

All electrically insulating substances having a correspondingly high thermal conductivity of at least 1 W/K×m, preferably 1.5 W/K×m, in particular at least 3 W/K×m (ceramic or epoxy resin with inorganic filling material, in particular with the smallest possible porosity in each case) are suitable, but electrically

conductive substances such as metals are not suitable, since short circuits would otherwise occur. In the case of composite materials, it is important that at least the surface facing the LEDs is electrically insulating (apart, possibly, from a local conductive covering layer).

The LEDs 2 are soldered onto the support, which has a rectangular basic form, using SMD technology.

Additional components such as reflectors are not required because the distance between the LEDs is only 1.5 mm on each side of the rectangular housing.

Figure 2 shows a further surface lighting luminaire 5, in which, in addition to an array of LEDs 6, an integrated circuit 7 is also applied on the ceramic board forming the support 8. In order to ensure homogeneous emission in this case, the covering 9 is embodied as a diffusing screen. This luminaire has a base area of about 4×3 cm^2.

Owing to the narrow distance a (row distance) and b (column distance) between the LEDs, the structural height of the housing of the luminaire can be drastically reduced, to be precise by about 30 to 50%, compared with conventional technology. This is because there is approximately a linear relationship between the lateral distance and the structural height. Approximately a structural height of 15 mm has to be observed given a lateral distance of 10 mm, while the structural height can be reduced to approximately 7 mm given a distance of a = 5 mm and b = 4 mm.

Claims

1. Optoelectronic component group which is mounted on a support (3) and which comprises at least two adjacent LEDs (2) at a prescribed distance (a), and also associated connecting lines (4), characterized in that the support (3) is composed of a material having a thermal conductivity of better than 1 W/K×m, in particular of at least 1.5 W/K×m.

2. Optoelectronic component group according to Claim 1, characterized in that the support is composed of a material which can be populated by means of SMD technology.

3. Optoelectronic component group according to Claim 1, characterized in that the support is composed of a material which is selected from the group consisting of ceramic, non-conducting cermet, plastic and/or composite material.

4. Optoelectronic component group according to Claim 1, characterized in that at least one further component (7) is fixed on the support.

5. Optoelectronic component group according to Claim 3, characterized in that the component is an electronic circuit, in particular an integrated circuit or complete drive circuit, or an LED.

6. Optoelectronic component group according to Claim 1, characterized in that the component group is a component part of a surface lighting luminaire or lamp.

7. Optoelectronic component group according to Claim 1, characterized in that a plurality of LEDs (2) are arranged regularly on the support.

8. Optoelectronic component group according to Claim 7, characterized in that the LEDs (2) form a section or an array, with a prescribed distance (a and b) in the rows and columns, respectively.

9. Optoelectronic component group according to Claim 6, characterized in that the distance between two adjacent LEDs is at most 5 mm, preferably less than 2 mm.

10. Optoelectronic component group according to Claim 1, characterized in that the support is mounted on a further heat-dissipating material, in particular a separate thermal plate or body parts of a vehicle.

11. Optoelectronic component group according to Claim 2, characterized in that further, in particular electronic component parts are integrated on the support.

12. Optoelectronic component group according to Claim 6, characterized in that the structural height of the group is less than 10 mm.

13. Optoelectronic component group which is mounted on a support (3) and which comprises at least two adjacent LEDs (2), which are spaced apart from one another, and also associated connecting lines (4), characterized in that the support (3) is composed of a material which dissipates heat well enough to realize a distance between adjacent LEDs of at most 5 mm, preferably less than 2 mm, without limiting the specified forward current of the LEDs and without further aids.

Abstract

An optoelectronic component group has at least two LEDs (2) which are mounted on a support (3). The support is composed of a material having a thermal conductivity of better than 1 W/K×m, for example ceramic or composite material.

Figure 1

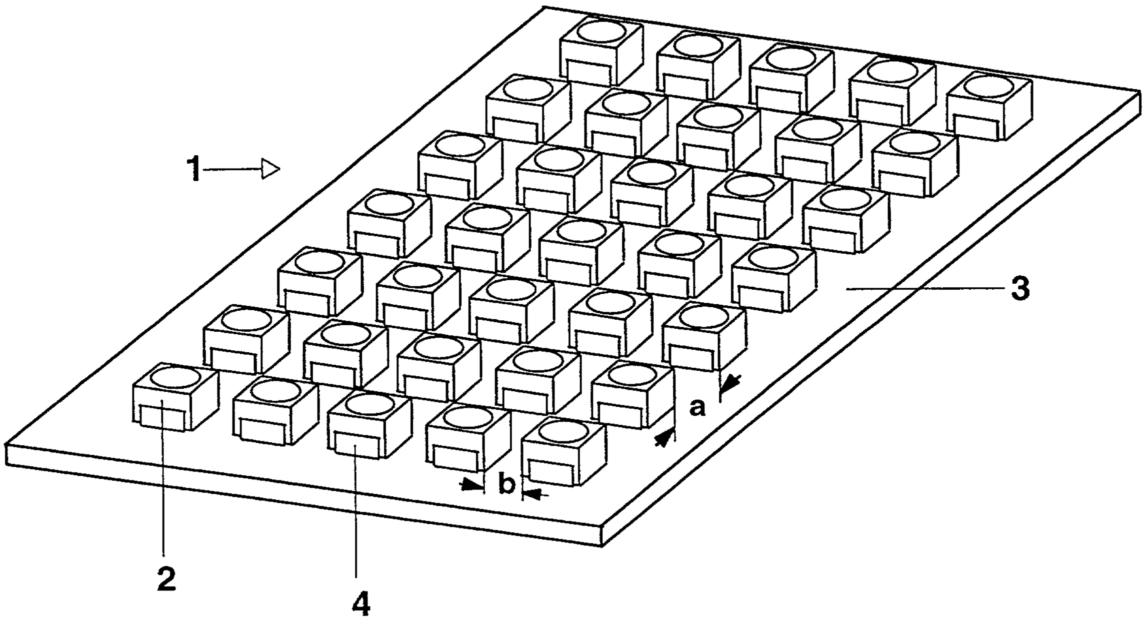

FIG. 1

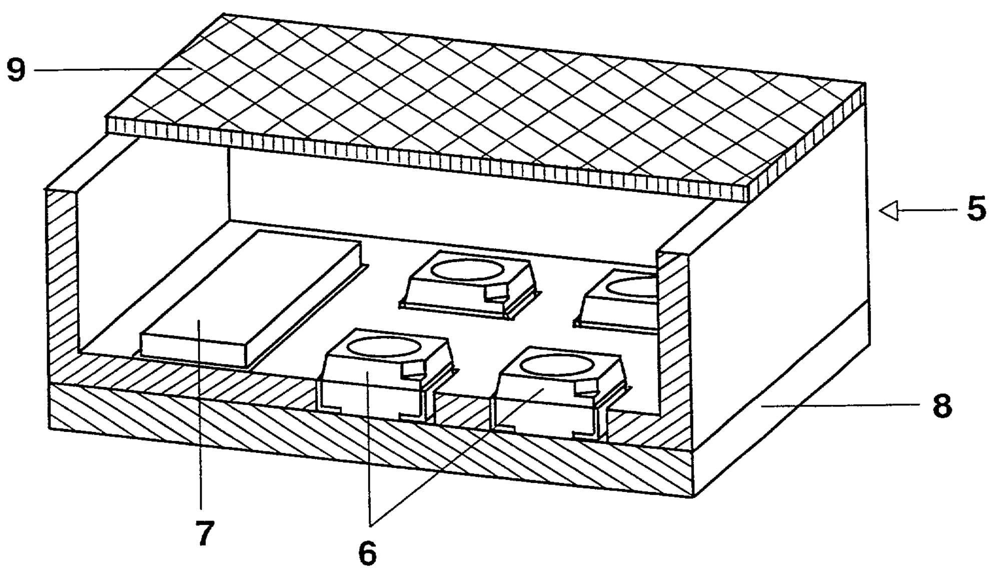

FIG. 2

APPLICATION FOR UNITED STATES LETTERS PATENT

DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I declare that:

my residence, post office address and citizenship are as stated next to my name; I believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural inventors are named below) of the invention which is described and which is claimed in the specification, entitled:

Optoelectronic component group

The specification is attached hereto.
I have reviewed and understand the contents of said specification, including claims.
I acknowledge the duty to disclosure information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulation, Section 1.56(a).

I claim foreign priority benefits under Title 35 United States Code, Section 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application(s) for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

COUNTRY	APPLICATION NUMBER	DATE (month, day, year)	PRIORITY CLAIMED
Fed. Rep. Germany	199 31 689.9	July 8, 1999	YES__X__No___.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

I appoint the following to prosecute this application and to transact all business in the U.S. Patent & Trademark Office connected therewith: Carlo S. Bessone, Reg. No. 30,547; Robert F. Clark, Reg. No. 33,853; William E. Meyer, Reg. No. 30,719; and William H. McNeill, Reg. No. 24,426.

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